March 30, 1954 W. G. SHERMAN ET AL 2,673,557

PNEUMATIC GUN

Filed Oct. 30, 1950

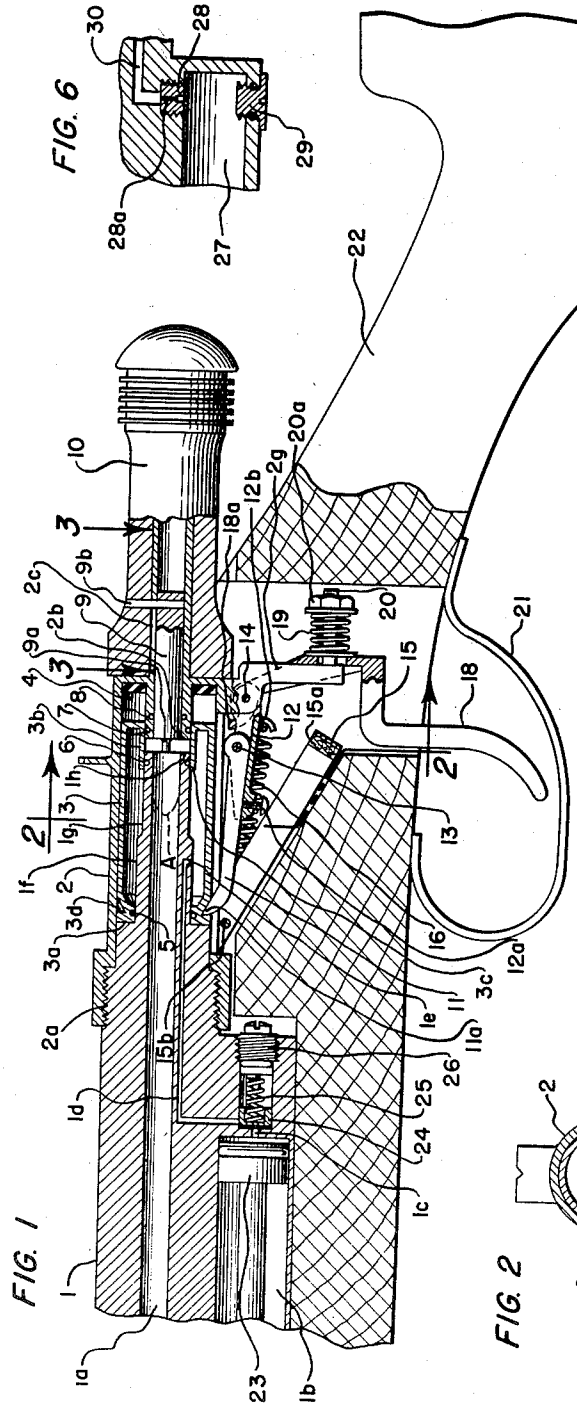


FIG. 1

FIG. 6

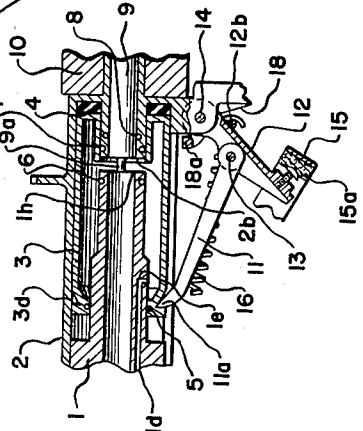


FIG. 5

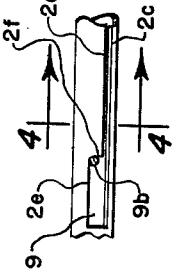


FIG. 3



FIG. 4

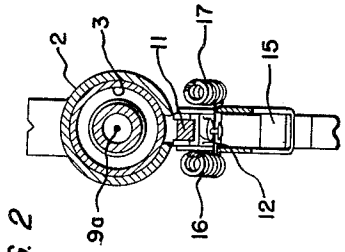


FIG. 2

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Patented Mar. 30, 1954

2,673,557

UNITED STATES PATENT OFFICE

2,673,557

PNEUMATIC GUN

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Application October 30, 1950, Serial No. 192,875

12 Claims. (Cl. 124—11)

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Our invention relates to a pneumatic gun, and more particularly to a pneumatic gun having novel air-releasing valve mechanism, and the objects of our invention are:

First, to provide a pneumatic gun of this class having an air release valve which is opened by air under pressure which passes from the pressure chamber into the barrel of the gun;

Second, to provide a pneumatic gun of this class having a novel toggle-operated sear engaging a pressure-operated valve, whereby exhaustion of pressure by said valve into the barrel of the gun permits springs in connection with said toggle-operated sear to return said valve to closed position automatically;

Third, to provide a pneumatic gun of this class having novel valve means which exposes the entire periphery of the rear end of the gun barrel to air pressure, whereby very rapid release of air from the air chamber to the breech of the barrel is accomplished;

Fourth, to provide a pneumatic gun of this class which does not require any cocking of valve-releasing plungers during the operation thereof;

Fifth, to provide a pneumatic gun of this class which is readily adapted to operate with very high pressures;

Sixth, to provide a pneumatic gun of this class having valve means which is adapted to operate at very high pressures, due to the thrust differential on the valve by air pressure, which tends to open the valve with a certain amount of force proportional to the pressure of air in the air chamber;

Seventh, to provide a pneumatic gun of this class which is readily adapted for use in propelling projectiles by means of dry ice expansion, or by any other suitable high-pressure gas;

Eighth, to provide a pneumatic gun of this class in which the trigger pull may be very light and smooth, and in which moving mechanism during the shooting thereof is predominantly axial of the barrel, whereby extreme accuracy is promoted;

Ninth, to provide a pneumatic gun of this class having a valve means which exposes the entire periphery of the breech end of the barrel to air pressure, causing uniform propelling action on the projectile in the barrel, which greatly promotes accuracy;

Tenth, to provide a pneumatic gun of this class having valve means which subjects the projectile in the barrel to the optimum pressure very quickly, whereby the maximum velocity of the projectile proportional to the air pressure and

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volumetric displacement of the chamber is attained; and

Eleventh, to provide a pneumatic gun of this class which is very simple and economical of construction, efficient in operation, and which will not readily deteriorate or get out of order.

With these and other objects in view, as will appear hereinafter, our invention consists of certain novel features of construction, combination and arrangement of parts and portions, as will be hereinafter described in detail and particularly set forth in the appended claims, reference being had to the accompanying drawings and to the characters of reference thereon, forming a part of this application, in which:

Fig. 1 is a fragmentary side elevational view of our pneumatic gun, showing portions broken away and in section on a substantially vertical plane through the axis of the gun; Fig. 2 is a fragmentary sectional view, taken from the line 2—2 of Fig. 1; Fig. 3 is a fragmentary sectional view, taken from the line 3—3 of Fig. 1; Fig. 4 is a transverse sectional view, taken from the line 4—4 of Fig. 3; Fig. 5 is a fragmentary sectional view on the same plane as the structure shown in section in Fig. 1 of the drawings, illustrating the valve of the pneumatic gun in open position, and the toggle sear mechanism pivoted backwardly; and Fig. 6 is a fragmentary sectional view of a modified form of the mechanism showing a gas chamber adapted to supply carbon dioxide gas or the like to the valve of the gun.

Similar characters of reference refer to similar parts and portions throughout the several views of the drawings.

The barrel 1, valve casing 2, valve member 3, cushion 4, sealing rings 5, 6, 7 and 8, bullet-seating bolt 9, bolt handle 10, sear 11, toggle 12, pins 13 and 14, toggle stop 15, toggle springs 16 and 17, trigger 18, trigger spring 19, adjusting screw 20, trigger guard 21, stock 22, pump plunger 23, check valve 24, spring 25, and the plug 26, constitute the principal parts and portions of our pneumatic gun.

The barrel 1 of our pneumatic gun is provided with a bore 1*a* which may be rifled or may be adapted to shoot shot, or other projectiles as desired. The barrel 1 is provided with a pump cylinder 1*b* connected therewith, in which a conventional pump plunger 23 is reciprocally mounted, which communicates through an orifice 1*c* with the check valve 24, held by the spring 25, which is abutted to the plug 26. Communicating with the check valve 24 is an air passage 1*d*, which extends rearwardly to the vent portion 1*e*

thereof. This vent portion 1e is positioned at a reduced outside diameter portion 1f of the barrel 1, on which the forward end 3a of the valve member 3 is slidably mounted.

This end portion 3a of the valve member 3 is provided with an annular groove in which the resilient sealing ring 5 is positioned. This resilient sealing ring 5 traverses and seals upon the reduced in diameter portion 1f of the barrel 1. Integral with the reduced diameter portion 1f is a further reduced outside diameter portion 1g, on which the rear end portion 3b of the valve member 3 is slidably mounted. It will be noted that the further reduced in diameter portion 1g provides for a pressure differential area between opposite ends of the valve member 3 when gas is under pressure therein, causing a tendency of the valve member 3 to move rearwardly toward the cushion 4, which is held within the valve casing 2.

The sealing ring 6 is positioned in an annular groove externally of the reduced in diameter portion 1g, and is engaged by the slidable rear end portion 3b of the valve member 3. This sealing ring 6 is near the rear open end 1h of the barrel 1, all as shown best in Fig. 1 of the drawings.

The valve casing 2 is a hollow cylindrical casing having a screw-threaded portion 2a, screw-threaded on the barrel 1 and extending slightly forwardly of the reduced diameter portion 1f of the barrel 1. This valve casing 2 surrounds the annular hollow cylindrical valve 3, which is considerably larger in internal diameter than the external diameter of the reduced barrel portion 1f, providing an air chamber within said valve member 3, which at all times communicates with the opening 1e of the passage 1d, as hereinbefore described. The rear end of the valve member 3 is provided with an inwardly disposed end portion 3b, which is an elongated sleeve structure adapted to overlap the rear end portion 1h of the barrel 1, and the forwardly extending hollow cylindrical portion 2b of the valve casing 2.

This hollow cylindrical portion 2b is substantially identical in diametrical measurement with the reduced barrel portion 1g, and the bore 1a of the barrel 1. The bullet-seating bolt 9 is slidably mounted longitudinally in the internal bore of the hollow cylindrical portion 2b of the valve casing 2, and is engaged by the sealing ring 8 therein. It will be noted that the sealing rings 6 and 7 on the portions 1g and 2b, respectively, are engageable with the portion 3b of the valve member hereinbefore described.

It will be noted that the cushion 4 is positioned rearwardly of the valve member 3, within the valve casing 2, and is adapted to stop the rearward movement of the valve member 3 when the forward edge 3c of the hollow cylindrical portion 3b of the valve member 3 moves backward into substantially flush position with the forward end of the hollow cylindrical portion 2b of the valve casing 2.

The bullet-seating bolt 9 is provided with a small diameter punch 9a at its forward end, adapted to force a bullet, as indicated by dash lines A, into the bore 1a of the barrel 1. Extending through the bullet-seating bolt 9 is the pin 9b, which also extends into the bolt handle 10, and is slidably mounted in a slotted portion 2c in the hollow cylindrical portion 2b of the valve casing 2, all as shown best in Figs. 1 and 3 of the drawings. This slotted portion 2c is provided with a straight narrow slotted portion 2d and an offset portion 2e, providing a shoulder 2f

on which the pin 9b may be locked for holding the bullet-seating bolt 9 forwardly in the position as shown in Fig. 1 of the drawings. The offset portion 2e is also wide enough to receive a bullet A, which may be loaded into the bore when the bullet-seating bolt 9 is rearwardly of said portion 2e of said slot 2c.

Fixed to the valve casing 2 is a downwardly extending arm 2g, through which the pin 14 extends, pivotally mounting the trigger 18 and the toggle member 12 thereto. Pivotally mounted on the toggle member 12 by means of the pin 13 is the sear 11. This sear 11 is provided with a sharp end portion 11a, engaging the annular groove 3d of the valve member 3, all as shown best in Figs. 1 and 5 of the drawings. Screw-threaded in the toggle member 12 is an adjusting screw 12a, engageable with the sear 11 for adjusting the over-center relationship of the pin 13 relative to the pin 14 and the end portion 11a of the sear 11.

The trigger 18 is provided with a toggle-engaging arm portion 18a which engages the upper side of the toggle member 12 for forcing the same downwardly and causing the pin 13 to pass over-center relative to the pin 14 and the end 11a of the sear 11. Fixed to the arm 2g, extending downwardly from the valve casing 2, is the screw 20 on which the spring 19 is positioned, held in adjustment by the nut 20a. This spring 19 tends to hold the trigger 18 forwardly against the arm 2g and the tension of this spring may be adjusted by means of the nut 20a to vary the pull weight of the trigger, as desired.

The toggle stop 15 is provided with a cushion 15a, adapted to stop the rearward travel of the toggle 12 when the toggle structure of the sear 11 and toggle 12 is broken by pulling the trigger 18. The springs 16 and 17 are secured at their rear end portions to the pin 12b on the toggle member 12, and are secured at their forward ends to the pin 15b on the toggle stop 15. These springs 16 and 17, at opposite sides of the toggle 12, are tension springs tending to force the sear 11 and toggle 12 forwardly into the solid line position, as shown in Fig. 1 of the drawings, wherein the sear 11 holds the valve member 3 forwardly, and in which the pin 13 is in over-center position relative to the pin 14 and the end 11a of the sear 11.

The operation of our pneumatic gun is substantially as follows:

When it is desired to propel the bullet A through the bore 1a of the barrel 1 by compressed air, the operator operates the conventional pump plunger 23, forcing air through the orifice 1c, past the check valve 24 and into the passage 1d, from which it is exhausted at the terminus 1e into the interior of the valve member 3, intermediate the sealing ring 5 and the sealing ring 6. When sufficient air has been compressed into the interior of the valve member 3, the bolt handle 10 may be turned in a counter-clockwise direction, releasing the pin 9b from the shoulder 2f. Then the bolt handle 10 may be pulled backwardly until the pin 9b has traversed the full length of the portion 2d of the slot 2c. At this position, the punch 9a of the bullet-seating plunger 9 is disposed rearwardly of the enlarged portion 2e of the slotted portion 2c of the valve casing 2.

A bullet may be inserted in said enlarged portion 2e of the slot 2c and subsequent closing of the bolt 9 into the position as shown in Fig. 1 of the drawings seats the bullet in the rear end

of the bore 1a, substantially flush with the rear end 1h thereof. When the bolt handle 10 is forced forwardly to the position as shown in Fig. 1 of the drawings, it is rotated in a clockwise direction until the pin 9b is locked on the shoulder 2f, as shown in Fig. 3 of the drawings, firmly supporting the bullet-seating bolt 9 in the position shown in Fig. 1, wherein the punch portion 9a only projects intermediate the rear end 1h of the barrel 1, and the forwardly extending end 2b of the hollow cylindrical portion within the valve casing 2. The O-ring 8 seals the periphery of the bullet-seating bolt 9 within the valve casing 2, while the sealing rings 6 and 7 seal the rearward portion of the valve member 3 against loss of compressed air therein.

When the trigger 18 is pulled, it is resisted by compression of the spring 19, and pivots on the pin 14, causing the arm 18a to engage the toggle 12, forcing the pin 13 in connection therewith over-center relative to the pin 14 and the end 11a of the sear 11, which permits compressed air within the valve member 3 to force the valve member 3 backwardly against the cushion 4 until the forward edge 3c of the portion 3b substantially coincides with the front end 2b of the hollow cylindrical portion of the valve casing 2, hereinbefore described. Compressed air then rushes into the rear end 1h of the bore 1a of the barrel 1, around the entire periphery thereof, which propels the bullet longitudinally of the bore 1a.

As soon as the air is exhausted from the valve member 3, springs 16 and 17 force the toggle 12 and sear 11 upwardly into the position as shown in Fig. 1 of the drawings, carrying the valve member 3 to the solid line position as shown in Fig. 1, wherein it is again ready to be charged with compressed air, it being noted that the over-center pin 13 locks the valve member 3 in this position until released by the trigger 18.

The diametrical differential between the reduced diameter barrel portions 1f and 1g provides for a cross-sectional area differential between the forward and rearward ends of the valve member 3 at its interior, tending to force the member 3 backwardly toward the cushion 4 when compressed air is introduced through the opening 1e of the passage 1d.

It will be noted that when the valve member 3 moves backwardly, carrying the sear 11 and toggle 12 into the position as shown in Fig. 5 of the drawings, the toggle 12 engages the cushion 15a of the toggle stop 15, effectively preventing displacement of the end 11a of the sear 11 from the annular groove 3d in which it is continuously engaged.

In the modification as shown in Fig. 6 of the drawings, the bore 27 corresponds to the bore 1b, but is used for containing a charge of Dry Ice. At the outlet of this bore 27 is a metering orifice member 28, having a fine orifice 28a therein which communicates with a passage 30, corresponding to the passage 1d hereinbefore described. In operation, Dry Ice maintains the continuous pressure of substantially eight or nine hundred pounds per square inch in the bore 27, and passes through the metering orifice 28a into the interior of the valve member 3. Each time the trigger 18 is pulled and the valve member 3 moves backwardly, as hereinbefore described, the springs 16 and 17 return the valve member 3 to its forward position as shown in Fig. 1, as soon as the pressure decreases sufficiently. The slow metering of carbon dioxide gas from the Dry Ice through the opening 28a prevents the gas from building up sufficient pressure within the valve member 3 to resist the action of the springs 16 and 17 in moving the valve member 3 forwardly until the over-center pin 13 is in proper position.

It will be noted that the time required for the placement of a bullet in the bore 1a, as hereinbefore described, is sufficient for the passage of a proper amount of gas through the orifice 28a to build up an optimum pressure within the valve member 3.

Though we have shown and described a particular construction, combination and arrangement of parts and portions, and a certain modification, we do not wish to be limited to this particular construction, combination and arrangement, but desire to include in the scope of our invention the construction, combination and arrangement substantially as set forth in the appended claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In a pneumatic gun, a barrel having a bore therein, a source of compressed air, a valve member slidable on said barrel, the entire cross-sectional area of said bore exposed to said valve member, and means creating a pressure area differential directly on said valve tending to open the same for exposing the entire open rear end of said bore to said source of compressed air, about the entire cross-sectional area of said bore, a spring for returning said valve to closed position when the pressure within said source of compressed air is lowered, said spring action for returning said valve to closed position being automatic.

2. In a pneumatic gun, a barrel having a bore therein, a source of compressed air, a valve member slidable on said barrel, the entire cross-sectional area of said bore exposed to said valve member, and means creating a pressure area differential directly on said valve tending to open the same for exposing the entire open rear end of said bore to said source of compressed air, about the entire cross-sectional area of said bore, a spring for returning said valve to closed position when the pressure within said source of compressed air is lowered, said spring action for returning said valve to closed position being automatic, a sear directly engaging said valve member for releasing the same and permitting said cross-sectional area pressure differential to move said valve to open position.

3. In a pneumatic gun, a barrel having a bore therein, a source of compressed air, a valve member slidable on said barrel, the entire cross-sectional area of said bore exposed to said valve member, and means creating a pressure area differential directly on said valve tending to open the same for exposing the entire open rear end of said bore to said source of compressed air, about the entire cross-sectional area of said bore, a spring for returning said valve to closed position when the pressure within said source of compressed air is lowered, said spring action for returning said valve to closed position being automatic, a sear directly engaging said valve member for releasing the same and permitting said cross-sectional area pressure differential to move said valve to open position, toggle means on said sear for holding said valve member closed.

4. In a pneumatic gun, a barrel having a bore therein open at both ends, a valve slidably mounted on one end of said barrel and having

cross-sectional area pressure differential means, a source of compressed air communicating directly with said valve thereby to provide communication between said source of compressed air and said barrel by way of a direct passage, tending to open said valve and expose the entire cross-sectional area of one open end of said barrel to said source of compressed air, a spring for automatically closing said valve and shutting off communication with said source of compressed air and the one open end of said bore when pressure of said compressed air is reduced to a predetermined value.

5. In a pneumatic gun, a barrel, a hollow cylindrical valve member slidable externally of said barrel and larger in internal diameter than the external diameter of said barrel, a diametrical step portion in said barrel intermediate opposite ends of said valve member, means for sealing opposite ends of said valve member engaging said barrel, said barrel open near one end of said valve member, a valve casing surrounding said valve member and having an internally extending hollow cylindrical portion provided with a bore spaced from the open end of said barrel, said valve member having a sleeve portion adapted to overlap the space between the end of said barrel and said hollow cylindrical portion, a source of compressed air, having a passage extending through said barrel externally of said bore and communicating with the interior of said valve member.

6. In a pneumatic gun, a barrel, a hollow cylindrical valve member slidable externally of said barrel and larger in internal diameter than the external diameter of said barrel, a diametrical step portion in said barrel intermediate opposite ends of said valve member, means for sealing opposite ends of said valve member engaging said barrel, said barrel open near one end of said valve member, a valve casing surrounding said valve member and having an internally extending hollow cylindrical portion provided with a bore spaced from the open end of said barrel, said valve member, having a sleeve portion adapted to overlap the space between the end of said barrel and said hollow cylindrical portion, a source of compressed air, having a passage extending through said barrel-externally of said bore and communicating with the interior of said valve member, a sear tending to hold said valve member in position, whereby said overlapping portion covers the space between said barrel and said hollow cylindrical portion.

7. In a pneumatic gun, a barrel, a hollow cylindrical valve member slidable externally of said barrel and larger in internal diameter than the external diameter of said barrel, a diametrical step portion in said barrel intermediate opposite ends of said valve member, means for sealing opposite ends of said valve member engaging said barrel, said barrel open near one end of said valve member, a valve casing surrounding said valve member and having an internally extending hollow cylindrical portion provided with a bore spaced from the open end of said barrel, said valve member having a sleeve portion adapted to overlap the space between the end of said barrel and said hollow cylindrical portion, a source of compressed air, having a passage extending through said barrel externally of said bore and communicating with the interior of said valve member, a sear tending to hold said valve member in position, whereby said overlapping portion covers the space between said barrel and said hollow cylindrical portion, a spring tending to hold said sear in position for engagement with said valve member.

8. In a pneumatic gun, a barrel, a hollow cylindrical valve member slidable externally of said barrel and larger in internal diameter than the external diameter of said barrel, a diametrical step portion in said barrel intermediate opposite ends of said valve member, means for sealing opposite ends of said valve member engaging said barrel, said barrel open near one end of said valve member, a valve casing surrounding said valve member and having an internally extending hollow cylindrical portion provided with a bore spaced from the open end of said barrel, said valve member having a sleeve portion adapted to overlap the space between the end of said barrel and said hollow cylindrical portion, a source of compressed air, having a passage extending through said barrel externally of said bore and communicating with the interior of said valve member, a sear tending to hold said valve member in position, whereby said overlapping portion covers the space between said barrel and said hollow cylindrical portion, a spring tending to hold said sear in position for engagement with said valve member, a bullet-seating bolt in said hollow cylindrical portion rearwardly of the open end of said bore, adapted to insert bullets into said bore.

9. In a pneumatic gun, a barrel, a hollow cylindrical valve member slidable externally of said barrel and larger in internal diameter than the external diameter of said barrel, a diametrical step portion in said barrel intermediate opposite ends of said valve member, means for sealing opposite ends of said valve member engaging said barrel, said barrel open near one end of said valve member, a valve casing surrounding said valve member and having an internally extending hollow cylindrical portion provided with a bore spaced from the open end of said barrel, said valve member having a sleeve portion adapted to overlap the space between the end of said barrel and said hollow cylindrical portion, a source of compressed air, having a passage extending through said barrel externally of said bore and communicating with the interior of said valve member, a sear tending to hold said valve member in position, whereby said overlapping portion covers the space between said barrel and said hollow cylindrical portion, a spring tending to hold said sear in position for engagement with said valve member, a bullet-seating bolt in said hollow cylindrical portion rearwardly of the open end of said bore, adapted to insert bullets into said bore, said sear having a toggle member in connection therewith and a trigger adapted to break said toggle for permitting said valve member to move under differential air pressure for exposing the entire open end of said bore for releasing compressed air internally of said valve member into said bore and projecting a bullet therethrough.

10. In a pneumatic gun: a barrel having a bore therein; a source of compressed air; chamber means for storing said compressed air; valve means associated with said chamber means, said valve means being positioned radially adjacent to an inner end of said barrel; means creating a pressure area directly on said valve means tending to open same for exposing an open rear end of said bore to compressed air stored in said chamber means; passage means for conducting said compressed air from said chamber means

past said valve means to said open rear end of said bore; spaced sealing means positioned intermediate said valve means and said passage means axially on both sides of said passage means; independent means mechanically engaging said valve means for maintaining said valve means in a closed position; and means to release said independent means.

11. In a pneumatic gun: a barrel having a bore therein; a source of compressed air; a valve member positioned for slidable movement along a line parallel to the axis of said barrel and radially adjacent an inner end of said barrel; chamber means for storing said compressed air; means carried by said valve means and adapted to be acted upon by pressure of said compressed air in said chamber to open said valve; passage means for conducting said compressed air from said chamber means upon opening of said valve means; spaced sealing means positioned intermediate said valve means and said passage means axially on both sides of said passage means; independent means mechanically engaging said valve means for maintaining said valve means in a closed position; and means to release said independent means.

12. In a pneumatic gun: a barrel having a bore therein; a source of compressed air; a valve member positioned for slidable movement along a line parallel to the axis of said barrel and radially adjacent an inner end of said barrel; chamber means for storing said compressed air; means carried by said valve means and adapted to be acted upon by pressure of said compressed air in said chamber to open said valve; passage means for conducting said compressed air from said chamber means upon opening of said valve means; spaced sealing means comprising resilient rings, circular in cross section, positioned intermediate said valve means and said passage means axially on both sides of said passage means; independent means mechanically engaging said valve means for maintaining said valve means in a closed position; and means to release said independent means.

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